

base stations to estimate a bearing from the mobile device 10 to the respective base station 30. The processing circuitry 55 of the server 48 operates also to estimate, using the bearing, a position of the mobile device 10. Estimation of the position of the apparatus may involve using constraint information that is independent of the radio signals 50. The estimation may involve determining the position of the mobile device 10 along the bearing 82. Alternatively or in addition, it may involve using I and Q samples generated by plural base station receiver apparatuses 30 and using triangulation to determine the location of the mobile device 10.

[0122] The server 48 maintains an allow list 14 and a deny list 15. The deny list 15 and the allow list 14 are populated based on information received from the base stations 30, 40-45 and other sources. The deny list 35D and allow list 35A stored in the base stations 30, 40-45 may be copies of the allow list 14 and the deny list 15 that are produced by and stored at the server 48.

[0123] The deny list 15 includes a number of records, each of which includes an identifier or address relating to a different mobile device, for instance one of the mobile devices 10, 46, 47. Some or all of the records may also include a time field, including a time value. The time value may relate to a time at which the record was added to the deny list 15. Alternatively, the time may indicate an expiry time of the record. If no time value is included in a record, the record can be considered to be permanently present in the deny list, although it can be removed. Records may be added to the deny list 15 by an administrator or an external system, for instance. The inclusion of a record on the deny list 15 prevents the bearing/location of the identified mobile device 10, 46, 47 being determined by the server 48.

[0124] The allow list 14 allows a number of records, each including an identifier or address and a threshold value. Some or all of the records may also include a time value in a time field. The time value may relate to a time at which the record was added to the allow list 14. Alternatively, the time may indicate an expiry time of the record. The inclusion of a record on the allow list 14 indicates that a beacon signal transmitted by the corresponding mobile device 10, 46, 47 has been received relatively recently by one of the base stations 30, 40-45. The threshold value determines a minimum power that is needed by a signal received at a base station 30 for I and Q samples of the signal to be sent to the server 48 for processing. The threshold value may, for instance, be dependent on a measured power of a strongest signal received within a pre-determined time (if the signal was received prior to the pre-determined time, it would be expired). The threshold may for instance be a quantity below the power of the strongest signal. The threshold may be measured in dB, or some other logarithmic scale. The threshold may be 10 dB below the power of the strongest signal.

[0125] The processing circuitry 55 may be any type of processing circuitry. For example, the processing circuitry 55 may be a programmable processor that interprets computer program instructions 13 and processes data. The processing circuitry 55 may include plural programmable processors. Alternatively, the processing circuitry 55 may be, for example, programmable hardware with embedded firmware. The processing circuitry 55 may be a single integrated circuit or a set of integrated circuits (i.e. a chipset). The processing circuitry 55 may also be a hardwired, application-specific integrated circuit (ASIC). The processing circuitry may be termed processing means.

[0126] The processing circuitry 55 is connected to write to and read from the storage device 56. The storage device 56 may be a single memory unit or a plurality of memory units. [0127] The storage device 56 may store computer program instructions 13 that, when loaded into processing circuitry 55, control the operation of the server 48. The computer program instructions 13 may provide the logic and routines that enables the server 48 to perform the method illustrated in FIG. 5, described below.

[0128] The computer program instructions 13 may arrive at the server 48 via an electromagnetic carrier signal or be copied from a physical entity 21 such as a computer program product, a memory device or a record medium such as a CD-ROM or DVD.

[0129] Operation of the base station 30 will now be described with reference to the flow chart of FIG. 4. As a preliminary step, the base station 30 is provided with copies 35A and 35D of the deny list 15 and the allow list 14 lists that are produced by and stored at the server 48.

[0130] Referring to FIG. 4, operation starts at step S1 where a positioning signal or positioning beacon is received from the mobile device 10 at the base station 30. The base station 30 then partially processes the signal to demodulate the identifier from the signal, as explained above with reference to FIG. 2. The base station 30 also measures the power of the received signal, as explained above. The power may be measured in dB.

[0131] At step S2, the base station 30 determines whether the identifier (which constitutes an address) that is demodulated from the received positioning signal is included in the deny list 35D. On a negative determination, the operation proceeds to step S3. Here, the base station 30 determines whether the identifier is included in the allow list 35A. On a positive determination, the operation proceeds to step S4. Here, the base station 30 determines whether the measured power of the received signal exceeds the threshold provided in the record in the allow list 35A that includes the identifier. The threshold may have a value in dB.

[0132] In response to a positive determination, indicating that the received signal is nearly as powerful as or more powerful than a recently received signal with the highest power, the operation proceeds to step S5. Here, a positioning packet including the I and Q samples is formed by the message former 27 and sent to the server 48. Following step S5, the base station 30 updates the deny and allow lists 35A, 35D at step S6. Following step S6, the operation proceeds again to await a new positioning signal at step S1.

[0133] In response to a positive determination from step S2, the I and Q samples are discarded at step S7 and the operation proceeds to step S6.

[0134] In response to a negative determination from step S4, the I and Q samples are discarded at step S8 and the operation proceeds to step S6.

[0135] Step S6 involves updating the deny and allow lists 35A, 35D to remove entries or records that have expired. For instance, where the deny and allow lists 35A, 35D include expiry times in time fields, step S6 involves deleting records where the value in the time field is in the past. Where the time fields of the deny and allow lists 35A, 35D include start times, step S6 may involve adding a validity time to the start time and determining whether the result of the addition is in the past. The validity time may be different for records in the deny list 35D than for records in the allow list 35A. For instance, the validity time for records in the allow list 35A may be of the